South Prairie Creek Salmon Habitat Protection Parcel Prioritization Methodology

Chris Davis
CommEn Space

Abstract
Productive salmon habitat is the product of a variety of processes, some of which are principally aquatic while others are terrestrial. Watershed land use patterns, access to historical side channels and flood plains, and riparian conditions are only some of the many physical measures that have been studied in an effort to quantify the relationship between landscape condition and in-stream habitat. In an effort to guide the land protection initiatives or a regional land trust, we conducted a parcel -based analysis of landscape conditions in South Prairie Creek in Pierce County. Additional data quantifying relative risk of future development of parcels contributing to functional habitat were developed and incorporated with biological data to prioritize lands for protection. This study suggests some methods for addressing the difficult spatial relationships that tie disparate land use patterns to aquatic conditions and incorporates planning and land use data into results being used to support further requests for land protection.

Background
This project is being conducted for the Cascade Land Conservancy in order to identify the most desirable parcels for protection based upon salmon habitat characteristics. The area of analysis is South Prairie and Wilkeson Creeks in Pierce County. The unit of analysis is the parcel, and the final product of this analysis is a ranked list of parcels and the data for the variables that were used to derive the ranking.

Methods

Part I: Selecting Parcels for Consideration in the Analysis
The first step in the analysis was to determine which parcels should be excluded from consideration in the final ranking using digital parcel data purchased from Pierce County GIS. In order to eliminate parcels, we decided to use FEMA Q3 flood data for South Prairie and Wilkeson Creeks. The Q3 flood data is the digital version of the Flood Insurance Rate Map (FIRM). We chose the flood plain as the selection mechanism in the interest of preserving hydrological connectivity between the parcels and the creek. However, the Q3 data for South Prairie creek has not been updated since 1981, and substantial development has occurred in and around the floodplain over the past 20 years. Pierce County is presently engaged in the update process of the floodplain delineation, and according to Jared Erickson at Pierce County, this work will be completed in December. It was his professional opinion that until the update is complete, the existing floodplain is the best available data and is appropriate to use for our purposes. In order to account for some of the development and hydro-modifications that have occurred in the area and to ensure that all parcels intersecting the floodplain were included in the analysis, I placed a 250-foot buffer around the floodplain before selecting parcels. Additionally, I performed a visual analysis with the parcel boundaries and a 10m digital elevation model to ensure that parcels extended to valley walls or other substantial changes in elevation in those areas of minimal relief that were not covered by the buffered flood plain. As a final step, I overlayed the SSHIAP line coverage for known salmonid presence to identify those parcels containing salmon bearing streams that do not intersect the floodplain.

Parcels were selected along South Prairie Creek between SSHIAP segment 9 (roughly the intersection of the Creek and Burnett Bridge) and the confluence with the Carbon River, and along Wilkeson Creek between SSHIAP segment 6 and the confluence with South Prairie Creek. Upstream of these locations both creeks are incised, follow a much steeper gradient, and contain significant blockages to fish passage.

Part II: Deriving Habitat Measures/Biological Variables
Six variables were used in this analysis:

1. The percentage of a parcel covered by floodplain.
2. The percentage of a parcel covered by aquifer recharge areas.
3. The percentage of a parcel covered by wetlands.
4. The length of creek passing through each parcel.
5. The percentage of a parcel covered by trees.
6. The size of the parcel.

Percentage of Parcel Covered by Floodplain
This variable was included due to the minimal relief in the South Prairie Creek area and to preserve groundwater connections and surface water processes between the stream channel and the floodplain.

The data source is the Federal Emergency Management Agency's Q3 digital flood data. The 100-year flood plains for South Prairie and Wilkeson creeks were selected out of the data and "unioned" with the parcels coverage. The variable was derived by dividing the area of floodplain covering each parcel by the total area of the parcel.

One potential problem associated with this variable is that the current extent of the floodplain might be underestimated due to increased development over the 20 years since the flood boundaries were last updated.

Percentage of Parcel Covered by Aquifer Recharge Areas
This variable was included as another measure of hydrological connectivity between the stream channel and the surrounding landscape. Aquifer recharge areas were identified as one significant variable in a recent study completed by Pess et al., which examined the relationship between landscape characteristics and Coho salmon abundance in the Snohomish river.

The data was obtained from Pierce County GIS. The variable was derived by dividing the area of aquifer recharge covering each parcel by the total area of the parcel.

One potential problem associated with this variable is the methodology used to generate the aquifer recharge areas. This theme was created from parts of three other data themes: Ground Water Pollution Potential (DRASTIC), Chamber's/ Clover Creek Aquifer and well-head buffer (an internally used data file). Unfortunately there is no documentation in the metadata for these original data sources and it is unclear how accurate they are.

Percentage of Parcel Covered by Wetlands
This variable was included because of the importance of wetlands as side channel habitat and as another measure of hydrological connectivity.

The data was obtained from the National Wetlands Inventory as six individual 1:24,000 quads. The quads were joined together and the boundaries between coverages were dissolved. The variable was derived by dividing the area of wetlands covering each parcel by the total area of the parcel.

Unfortunately the NWI maps are not updated regularly and some of the wetlands included in the digital coverage have been drained, filled, and developed. This may result in inaccurate scores for some parcels for this variable.

Length of Stream Passing Through Parcel
This variable was included as a measure of streamside habitat within a parcel.

The data for this variable is the known salmonid presence coverage obtained from SSHIAP. The variable was derived by identifying the longest stretch of the creek passing through a study area parcel, and all other stretches of stream were normalized against this value by dividing the length of each creek segment by the length of the longest segment. The result is a score from 0 to 1 with 0 equal to no creek length at all and 1 equal to the longest possible segment.

One potential problem associated with this variable is the mismatch between parcel boundaries and the actual location of the creek. In many instances the physical location of the creek has changed since the parcel boundaries were originally platted and this can lead to both commission and omission errors for this variable.

Percentage of Parcel Covered by Trees
This variable was included because of the important contribution trees make to salmon habitat in the form of wood recruitment, shading the stream channel, stabilizing banks, retaining groundwater, and slowing overland flow.

The data source for this variable was derived from Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) satellite imagery. Two scenes were georeferenced using the streets and parcel boundaries for the study area with twenty-two control points per scene. Eight classes of landcover were derived using a supervised minimum distance to means classification. Training sites were digitized for agriculture, baresoil/metal, grass/lightly vegetated, conifer, deciduous trees/shrubs, mixed woods, developed, and water. The three forested classes were combined to form a single

class which was used as the total forested area for each parcel. The variable was derived by dividing total forested area by the total area of the parcel.

The largest potential problem associated with this variable is the resolution of the source data. ASTER uses 15m cells, and although this is acceptable resolution for many applications, it may be too coarse for a parcel-based analysis. In many cases a positional error of just one cell can drastically change the score for a small parcel. An additional problem is some class confusion between the deciduous and agricultural categories. Furthermore, while the delineation of forested classes is fairly accurate, it does not contain any information on species composition or the size of the trees, both of which are also important considerations.

Part III: Deriving a Composite Score and Ranking for Each Parcel

Each variable ranges from 0 – 1 with zero the least desirable and one the most desirable. The score for each parcel was determined by adding the six variables together and dividing by six:

$$\frac{((\%\ \text{flood}) + (\%\ \text{aquifer}) + (\%\ \text{wetland}) + (\%\ \text{creek length}) + (\%\ \text{forest}) + (\%\ \text{size}))}{6}$$

The result is a percentage score for each parcel. Scores were generated independently for South Prairie and Wilkeson Creeks.

Parcels were ranked twice, once for all parcels regardless of ownership or vacancy, and again for those parcels that are vacant and privately owned. The highest score received a rank of one, and rankings increase as scores decrease.

Incorporating Salmon Abundance and Spawning Data

Salmon spawning and abundance data was received from Chuck Baranski of the Washington Department of Fish and Wildlife. Chinook redd locations from 2001 were provided with geographic coordinates recorded by GPS and ground survey data was provided for 1998-2000. River mile information was provided in hard copy format and manually digitized. River mile counts for the three years were summed and mapped. Both the GPS and ground survey data were overlaid with ranked parcels to identify those parcels with high rankings that are also in close proximity to high fish and/or redd densities.